

# Circadian and ultradian rhythms of activity and O<sub>2</sub>-consumption in three nocturnal Marsupialian species: *Petaurus breviceps*, Phalangeridae; *Dasyuroides byrnei*, Dasyuridae; *Monodelphis domestica*, Didelphidae

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## Abstract

Carried out were simultaneous recordings of activity and O<sub>2</sub>-consumption in three nocturnal Marsupialian species (*Petaurus breviceps*, *Dasyuroides byrnei*, *Monodelphis domestica*) in the laboratory in order to obtain information about the circadian and ultradian organization of both parameters. In *Pb*, body temperature was recorded telemetrically, too. In a LD 12:12 (200:10<sup>-1</sup> lx) the average 24-h-pattern of activity and O<sub>2</sub>-consumption in *Pb* is usually bimodal, showing an increase of both parameters right after the beginning and a decline just before the end of the D-phase. The average daily pattern of activity and O<sub>2</sub>-consumption of *Db* is characterized by a more gradual increase after the onset and decrease before the end of the D-phase. In *Md* the average 24-h-pattern of both parameters is multimodal with 3 to 4 peaks. Both activity and O<sub>2</sub>-consumption also show a marked ultradian rhythm during D-phase in all three species. While *Pb* is active exclusively during the D-phase and has a constantly low level of activity and O<sub>2</sub>-consumption during L-phase, in *Db* both parameters can show ultradian variations during the L-phase as well. The masking effects of high light intensities are low in *Db*, whereas in *Pb* and *Md* short light pulses of 2 h when applied during the activity phase produce strong negative masking effects on activity and O<sub>2</sub>-consumption. The species-specific differences found in the circadian and ultradian organization of the parameters measured in the three Marsupialian species can be interpreted as adaptations to different life strategies.

## Introduction

Many of the behavioral and physiological parameters recorded in chronobiological studies show pronounced species-specific differences in their time course and response characteristics to environmental stimuli. Although the advantages of an endogenous temporal adaptation of an organism to its periodically changing environment are evident (ENRIGHT 1970; DAAN 1981), attempts to correlate species-specific characteristics of circadian rhythms with the ecological situation of the respective species are made relatively rarely. ERKERT and KRACHT (1978), who studied the variability of the freerunning circadian period, the resynchronization rate and the range of entrainment of the activity rhythm in five neotropical bat species, found that the insectivorous species *Molossus molossus* and *Molossus ater* showed a high flexibility in all three parameters as compared with the three frugivorous Phyllostomid species *Phyllostomus discolor*, *Glossophaga soricina* and *Sturnira lilium*. The authors discuss the high degree of plasticity of the circadian system of the insectivorous species as an adaptation to their food niche: predators should be able to adjust their activity rhythm to the activity rhythm of their prey. KENAGY and VLECK (1982), who compared the daily pattern of resting metabolic rate in 18 small mammalian species, found different 24-h-patterns of resting metabolic rate in species from different habitats: fossorial species like pocket gopher (*Thomomys talpoides*) and moles (*Scapanus townsendii*, *Scapanus orarius*) exhibit a rather small circadian variation of resting metabolic rate as compared with species, which are exposed to the outer light-dark-cycle.

By studying the characteristics of the circadian system of the three nocturnal Marsupialian species *Petaurus breviceps* (*Pb*), *Dasyuroides byrnei* (*Db*) and *Monodelphis domestica* (*Md*) in the laboratory, we intend to find out whether these species differing in food niche as well as in habitat, exhibit differences in the organization of their circadian systems, which can be correlated with their different "ways of life". The Australian gliding phalanger *Pb* is omnivorous and feeds on fruit, tree-exudates and insects. It lives arboreal in social nesting communities and has a well-developed olfactory communication system (SCHULTZE-WESTRUM 1965; SMITH 1980). *Db* is living in the deserts and grass-lands of Central Australia and feeds on small mammals and insects. It has been trapped in burrow complexes with a number of closely grouped entrance holes (ASLIN 1974). The South American *Md* is terrestrial to semiarboreal and builds nests among rocks and in logs. It feeds on small animals and insects, but takes fruit and seeds, too (WALKER 1968).

The recordings of the daily course of activity, O<sub>2</sub>-consumption and in *Pb* of body temperature, too, which are presented in this paper, were to show whether the three species exhibit differences in the daily pattern of these parameters, and furthermore should provide some basic information for further studies concerning the synchronization and resynchronization behavior of the underlying circadian systems. As the actual value of a physiological parameter showing circadian variations is not only determined endogenously by its circadian time course, but results from inhibiting or amplifying so-called masking effects of external factors as well, we also studied the masking effect of light on the circadian rhythms of activity and O<sub>2</sub>-consumption.

## Materials and methods

The experiments were carried out with two male and two female *Pb* and *Db* and with one male and one female *Md*. During the experiments the animals were housed individually in small wire-mesh cages (20 × 25 × 28 cm), placed in an acrylic metabolic chamber. The cages were furnished with nestboxes from which front and back plate were removed to guarantee a continuous air flow.

The animals were provided daily at varying times with food and water ad libitum. *Pb* was fed with a mush of condensed milk, honey and gruel, furthermore with a mixture of fruit and vegetables, occasionally supplemented by *Tenebrio*-larvae or boiled egg. *Db* was fed with *Tenebrio*-larvae, young mice and boiled egg, *Md* with young mice, boiled egg, fruit and vegetables. To avoid deficiencies, vitamins and restoratives were added (Murnil, Bayer; Osspulvit, Madaus; Protovita, Roche; Vitakalk, Marienfelde).

As entraining Zeitgeber a squarewave-LD with 12 h light of 200 lx and 12 h darkness of 10<sup>-1</sup> lx for *Pb* and *Db* and of 10<sup>-3</sup> lx for *Md* was used. Ambient temperature was 25 ± 1 °C in all experiments.

The animals' activities were recorded by an electroacoustical method designed by BAY (1976). The substrate-conducted sounds produced by the animals' activities were picked up by special microphones (Merula TVJ-XL) and used to trigger series of squarewave pulses via an amplifier circuit set-up. A computer-controlled data collection device (Demel V224, Apple IIE) added these pulses and stored and printed out the results in 5- and 15-min-intervals.

O<sub>2</sub>-consumption was measured continually in an open-flow oxygen-analyzing system (Hartmann und Braun, Magnos 2T). The flowrate was 44 l/h. The baseline was corrected once a day during feeding time. The animals were weighted before and after an experiment. For the calculations of average O<sub>2</sub>-consumption (ml O<sub>2</sub>/g · h) during L- and D-phase the mean body weight was used. Since in a few longer-lasting experiments the body mass varied up to 20 %, in Figures 1, 2, 4, 5 the individuals' O<sub>2</sub>-consumption was plotted in ml/h only. All values are reduced to standard conditions (0 °C, 760 Torr). In *Pb*, the largest of the three species, the body temperature was measured telemetrically by miniature transmitters (Mini-Mitter, Mod T), which were embedded in paraffine (Elvax) and implanted i.p. under Ketamine-anaesthesia (Ketanest, Parke-Davis, 70–100 mg/kg). The transmitter signals were picked up with a CB-walkie-talkie and decoded by a microprocessor (M6502) set-up (BAIER). Body temperature was recorded in 5-min-intervals.

## Results

In a LD 12:12 all three species exhibit a marked daily variation in the level of activity and  $O_2$ -consumption. For each animal studied Fig. 1 shows the daily course of the two respectively three parameters as averaged in one-hour-intervals over at least five successive days. *Pb* (top) is active nearly exclusively during D-phase. Three of four animals show a bimodal pattern of activity and  $O_2$ -consumption with maximal values of both parameters right after the beginning and shortly before the end of the D-phase. One animal exhibits a unimodal pattern of activity and  $O_2$ -consumption. The increase of  $O_2$ -consumption during D-phase averages 38.5 % referring to L-values (100 %). The mean body temperature in the male *Pb*-individual is  $36.0 \pm 0.2$  °C during L-phase and  $37.0 \pm 0.1$  °C during D-phase, the average maximum-minimum-range amounts to 2.6 °C. In *Tb*-recordings carried out in another experiment without simultaneous measurements of  $O_2$ -consumption, the mean *Tb* of a female *Pb* was  $36.1 \pm 0.2$  °C during the L-phase and  $37.1 \pm 0.2$  °C during the D-phase. Here the average maximum-minimum-range amounted to 2.2 °C.

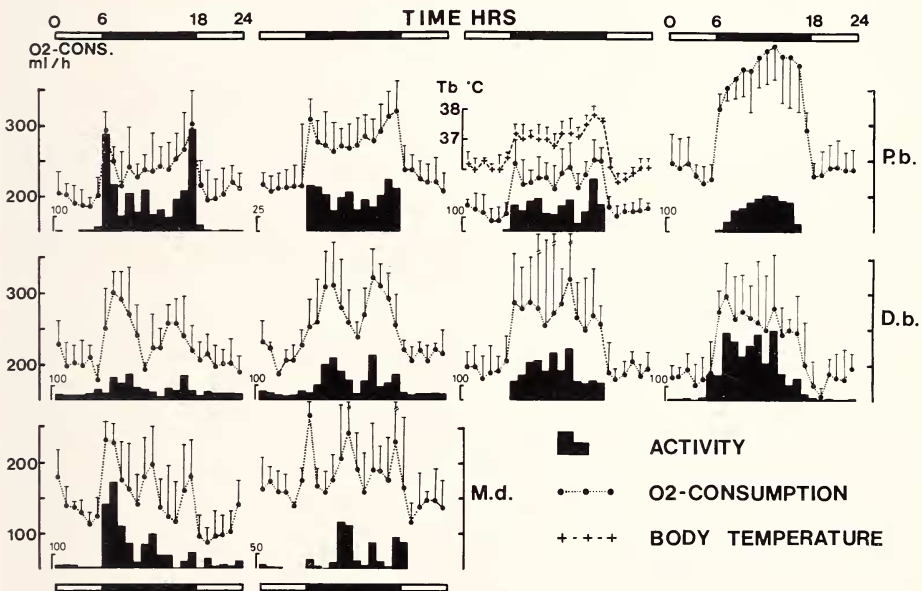


Fig. 1. Average 24-h-patterns of activity,  $O_2$ -consumption ( $\pm$  SD) and body temperature ( $\pm$  SD) in 4 *Petaurus breviceps* (top, from left to right: *Pb* 21, female, 165g; *Pb* 23, female, 193g; *Pb* 20, male, 141g; *Pb* 14, male, 153g), 4 *Dasyuroides byrnei* (middle: *Db* 15, female, 108g; *Db* 16, female, 113g; *Db* 21, male, 113g; *Db* 24, male, 129g) and 2 *Monodelphis domestica* (bottom: *Md* DO, female, 104g; *Md* AL, male, 140g) in a LD 12:12 of  $200 \cdot 10^{-1}$  lx for *Pb* and *Db*, and of  $200 \cdot 10^{-3}$  lx for *Md*. The data present hourly mean values of at least 5 days lasting registrations of the respective parameters

In *Db* the average pattern of activity and  $O_2$ -consumption is characterized by a gradual increase of both parameters after the beginning and a gradual decline before the end of the D-phase. The curves show two or three peaks in  $O_2$ -consumption. The average nocturnal increase amounts to 37.7 % (L = 100 %). Although in all test-animals the center of gravity of activity and  $O_2$ -consumption occurs in the D-phase, mainly the female *Dasyuroids* are active during the L-phase, too. In *Md* the average daily pattern of activity and  $O_2$ -consumption has three peaks. Maximal values of  $O_2$ -consumption occur just after the

beginning of the D-phase. The average increase of  $O_2$ -consumption during the D-phase equals 29 % (female) and 44 % (male).

In recordings of  $O_2$ -consumption carried out to determine standard metabolic rate, resting metabolic rate or average daily metabolic rate, the values of  $O_2$ -consumption per g body mass are compared. Therefore in Fig. 2 for each individual studied the overall mean values of  $O_2$ -consumption during the D- and L-phase of a LD 12:12 in ml  $O_2/g \cdot h$  are summarized.

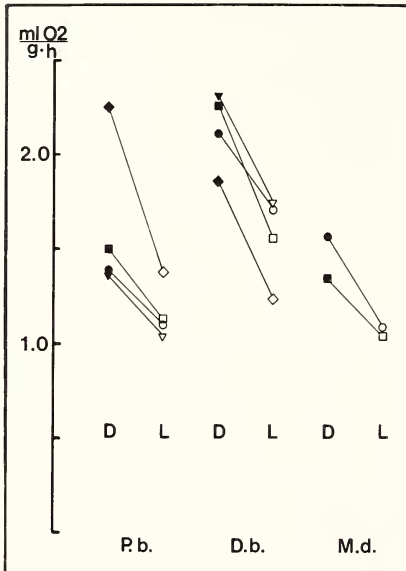


Fig. 2. Average  $O_2$ -consumption in ml  $O_2/g \cdot h$  during the L- and D-phase of a LD 12:12 of  $200 \cdot 10^{-1}$  lx for 4 *Petaurus breviceps* and 4 *Dasyuroides byrnei* and of  $200 \cdot 10^{-3}$  lx for 2 *Monodelphis domestica*

days plotted, the short-term rhythmicity of activity and  $O_2$ -consumption during L-phase is less pronounced than during the following two days of another registration period carried out later on. Here under identical LD-conditions activity and  $O_2$ -consumption reveal a pronounced short-term rhythmicity throughout the whole day. The tendency to longer lasting periods with such a polyphasic pattern of activity and  $O_2$ -consumption were obvious in the other *D.b.*-individuals, too. In *M.d.* the short-term rhythmicity of activity is characterized by rather long short-rest-times, in which  $O_2$ -consumption is low. Activity bouts during L-phase only occur occasionally.

To be able to compare the nocturnal short-term pattern in  $O_2$ -consumption of the three species, the average number of peaks in  $O_2$ -consumption per D-phase of the LD 12:12 was determined. For that purpose the mean  $O_2$ -consumption was calculated for each D-phase from the original data. All values exceeding this mean were regarded as bouts, all below were considered as short-rest-times. The resulting peak numbers were averaged over all experimental days and all individuals of a species. With 6.1 bouts of  $O_2$ -consumption per D-phase *Pb* proved to have the highest frequency; *D.b.* had 5.1 and *M.d.* only 4.3 bouts per D-phase.

In constant illumination conditions of  $10^{-1}$  lx (Fig. 3, days 6–10), the species-specific pattern of activity and  $O_2$ -consumption in *Pb* and *D.b.* corresponds to that in LD. *Pb* continues showing a marked change of a circadian activity phase composed of activity bouts and short-rest-times and a circadian rest-time with a constantly low level of activity

If instead of hourly mean values averaged over several days consecutive 15-min-values of activity and  $O_2$ -consumption are plotted (Fig. 3), it becomes evident, that in all three species activity is not displayed continually, but that its course is characterized by a striking short-term oscillation. Each activity bout is paralleled by an increase in  $O_2$ -consumption, during the short-rest-times  $O_2$ -consumption, and in *Pb* body temperature as well, declines. In *Pb*, which is active only during the D-phase,  $O_2$ -consumption and  $T_b$  hardly show any short-term variations during the L-phase of the entraining LD 12:12. All three parameters remain on a constantly low level. In contrast to this, *D.b.* exhibits short-term variations both during D- and L-phase. The amount of short-term oscillations of activity and  $O_2$ -consumption during L-phase is varying individually. As shown in Fig. 3, middle, where original data of two different registration periods from a female *D.b.* are combined, even within the same individual this short-term pattern during L-phase can vary considerably. In the first two



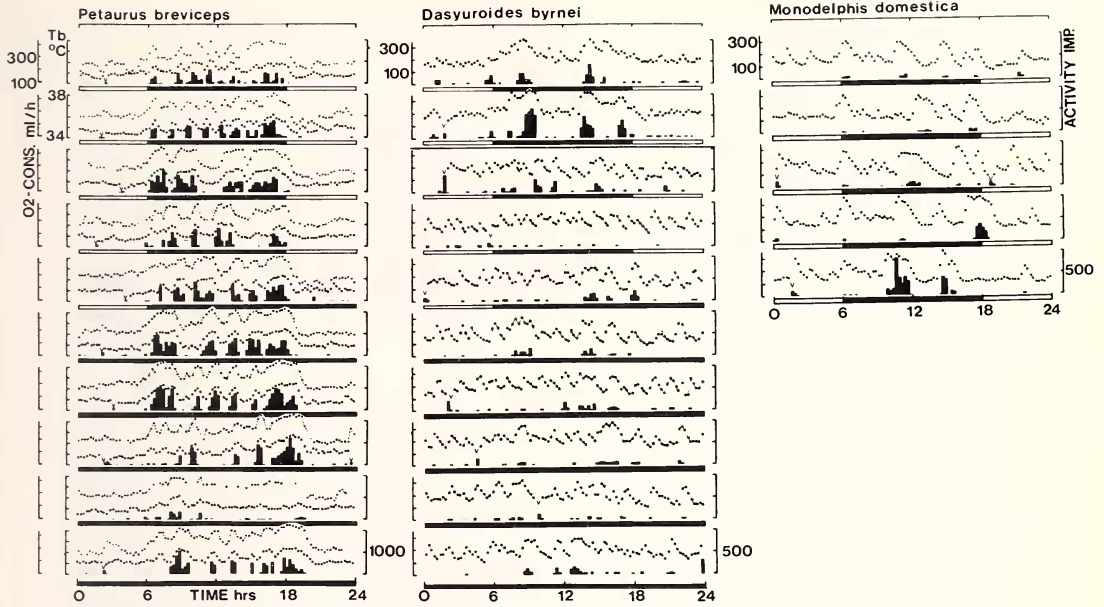


Fig. 3. Circadian and ultradian periodicity of activity (histograms), O<sub>2</sub>-consumption (dots) and body temperature (crosses) of a male *Petaurus breviceps* (left, 141g), a female *Dasyuroides byrnei* (middle, 113g) and a male *Monodelphis domestica* (right, 140g). The registered parameters are presented in 15-min-intervals. *Pb*: 5 successive days in LD 12:12 ( $200 \cdot 10^{-1}$  lx) followed by 5 successive days in LL ( $10^{-1}$  lx). *Db*: days 1–5 in LD 12:12 ( $200 \cdot 10^{-1}$  lx) and days 6–10 in LL ( $10^{-1}$  lx). Days 1 + 2 and days 3–10 are taken from different registration periods. For further explanation see text. *Md*: 5 successive days in LD 12:12 ( $200 \cdot 10^{-3}$  lx)

and O<sub>2</sub>-consumption. All three rhythms freerun internally synchronized with a period length of  $\tau = 24.2$  h. The *Db*-female during the LL-period exhibits a similar polyphasic pattern as in the preceding LD 12:12.

In order to test to what extent the daily course of activity and O<sub>2</sub>-consumption in the three Marsupialian species can be modified by masking effects of light, two individuals of each species were exposed to a 48-h-lasting high-frequency LD-regime of 2 h light to 2 h darkness. The stronger the masking effect of high light intensity, the more activity and O<sub>2</sub>-consumption should be reduced during the short-L-phases. Fig. 4 shows the reaction of one individual of each species to this short-term changes in illumination. In the *Pb*-female in the subjective night activity and O<sub>2</sub>-consumption are much higher during the short-D-phases than during the short-L-phases. In contrast to this, during the subjective day the course of activity and O<sub>2</sub>-consumption is little influenced by the short LD-cycles. In the *Md*-male the two parameters behave in a similar way. The *Db*-female on the other hand neither during the subjective night nor during the subjective day does show a marked decline of activity and O<sub>2</sub>-consumption during the short-L-phases. Nevertheless the pattern of activity and O<sub>2</sub>-consumption remains polyphasic. Fig. 5 summarizes the results of this experiment for all individuals studied. The bars indicate how many per cent the O<sub>2</sub>-consumption is higher in the short-D-phases than in the short L-phases, once for the subjective nights (dark bars), once for the subjective days (hatched bars) of the successive two experimental days. In *Pb* the pronounced masking effect of the higher light intensity depends on the circadian phase: in the subjective night O<sub>2</sub>-consumption declines during the short-L-phases, whereas in the subjective day there is nearly no reaction to the changes in light intensity. In *Db* the very low masking effect of light seems to be independent of the circadian phase hidden by the short light pulses. The two *Md*-individuals react differently:

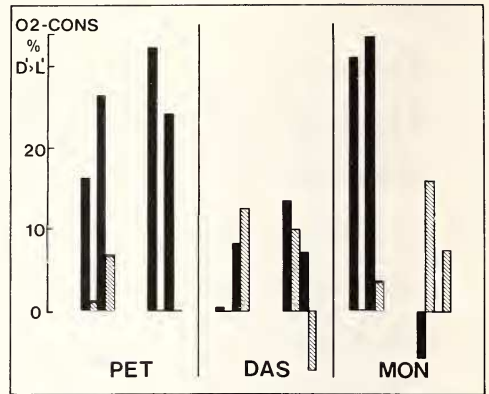
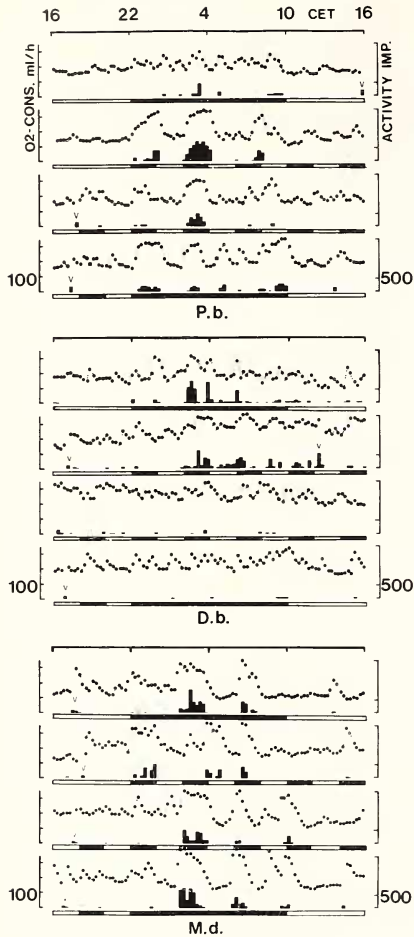


Fig. 5. Masking effect of a 48-h-lasting LD 2:2 of  $200:10^{-1}$  lx in *Petaurus breviceps* and *Dasyuroides byrnei*, and of  $200:10^{-3}$  lx in *Monodelphis domestica* on the 24-h-pattern of  $O_2$ -consumption. The animals were previously entrained to a LD 12:12. For each individual studied the histograms show how many per cent the  $O_2$ -consumption is higher during the short-D-phases than during the short-L-phases of the subjective nights (dark bars) and the subjective days (hatched bars) of the two successive experimental days

Fig. 4. Masking effect of light on the 24-h-pattern of activity (histograms) and  $O_2$ -consumption (dots) in a female *Petaurus breviceps* (top, 190g), a female *Dasyuroides byrnei* (middle, 111g), and a male *Monodelphis domestica* (bottom, 140g). Subsequent to a LD 12:12 ( $200:10^{-1}$  lx in *Pb* and *Db*, and  $200:10^{-3}$  lx in *Md*) the animals were exposed for 48 h to a high frequent LD 2:2 of equal L and D-illumination intensities, then the LD 12:12-regime was re-established

while the male-like *Pb*- shows higher values of  $O_2$ -consumption in the short-D-phases of the subjective night and no light induced variations of  $O_2$ -consumption during the subjective day, the female does not react to the short LD-changes in a consistent manner.

## Discussion

In a LD 12:12 the average daily pattern of activity and  $O_2$ -consumption in our three nocturnal Marsupialian species from different habitats and with different food-niches are differing considerably. While in *Pb* both parameters increase right after the beginning, decline just before the end of the D-phase and mostly show a bimodal pattern, the average pattern of activity and  $O_2$ -consumption in *Db* is characterized by a gradual nocturnal increase and decline. The unimodal pattern seems to be superimposed by two or three peaks. *Md* has a more or less trimodal average pattern of activity and  $O_2$ -consumption.

Part of the nocturnal increase of  $O_2$ -consumption (and in *Pb* of body temperature as well) in all three species is due to a masking effect of activity on  $O_2$ -consumption values. Because of the low level of standard metabolic rate in Marsupials on one hand (*Pb*:  $0.74 \text{ ml } O_2/\text{g/h}$ ,  $\bar{m} = 132.2 \text{ g}$ , FLEMING 1980; *Db*:  $0.87 \text{ ml } O_2/\text{g/h}$ ,  $\bar{m} = 89 \text{ g}$ , MACMILLEN and

NELSON 1969), and maximal values of  $O_2$ -consumption during locomotion comparable to Eutherian values (BAUDINETTE 1982) on the other hand, this masking effect of activity may be even higher in Marsupials than in Eutherians.

So in simultaneous recordings of activity and  $O_2$ -consumption each activity is necessarily accompanied by an increase in  $O_2$ -consumption, but not vice versa.  $O_2$ -consumption and body temperature can increase before locomotor activity starts, indicating that the beginning of the activity phase is not identical with the time when an animal has woken up (ASCHOFF and POHL 1970 in *Fringilla coelebs*; KLEINKNECHT unpublished, in *Molossus ater*). Such a phase leading of the rhythm of  $O_2$ -consumption to the activity rhythm, however, could not be found in any of our three Marsupialian species. Activity and  $O_2$ -consumption (in *Pb* body temperature, too) proved to have the same pattern and identical phase relation, in LD as well as in LL.

Activity and  $O_2$ -consumption (in *Pb* body temperature, too) in all three species show clear ultradian variations. Similar short-term-rhythms of activity and other parameters are described for many small Eutherian species (DAAN and ASCHOFF 1981) and seem to be a characteristic feature in Marsupials as well. In *Pb* this short-term rhythmicity in activity, body temperature and  $O_2$ -consumption is shown only during the D-phase of a LD 12:12, while *Db* can display a considerable, but individually varying amount of total activity during the L-phase, too. Within the same individual periods of a nearly polyphasic pattern of activity and  $O_2$ -consumption altered with times in which there was a clear center of gravity in the occurrence of bouts in activity and  $O_2$ -consumption in the D-phase. HALL (1980), who recorded the activity patterns of the two nocturnal Dasyuroid species *Antechinus stuartii* and *Antechinus swainsonii* in the field, found that *A. swainsonii* seasonally tends to be active day and night. The temporarily varying activity pattern of *Db* may also correlate with season. In our experiments the females tended to have a more polyphasic pattern than the males, whereas ASLIN (1974), who compared the activity pattern of one male and one female, found the male to exhibit much of its total activity during the L-phase.

*Pb*, *Db* and *Md* show species-specific differences not only in the circadian and ultradian pattern of the endogenous rhythms of  $O_2$ -consumption and activity, but also the extent to which both parameters can be influenced directly by high light intensities in *Pb* is considerably higher than in *Db*. In *Pb*, there is a strong masking effect of light, depending on the circadian phase encountered by the high illumination intensity. A circadian variation in the responsiveness to masking stimuli was shown by GANDER and MOORE-EDE (1983) in the diurnal squirrel monkey *Saimiri sciureus* as well. In *Db*, independently of the circadian phase,  $O_2$ -consumption and activity are only little influenced by light. Although only one of the two *Md*-individuals showed a clear response to the short-term changes in light intensity, a relatively high sensitivity to light intensity in *Md* is indicated by the fact that the animals increased the total amount of activity by 19 % (female) and 332 % (male) when the D-illumination intensity was reduced from  $10^{-1}$  to  $10^{-3}$  lx. That is why the experiments with *Monodelphis* were carried out with D-illumination intensities of  $10^{-3}$  lx.

In *Pb* an endogenous circadian rhythm with a constantly low level of activity and  $O_2$ -consumption during L-phase, which is hardly influenced by the actual light intensity, could be important for two behavioral characteristics of this social species which occur in the natural environment. First, *Pb* mainly during the cold season shows the thermoregulatory behavior of huddling, i.e. the members of a nesting community spend the daytime in tight physical contact to reduce their energy demand (FLEMING 1980). Second, the transfer of odours, which is necessary for the stabilization of a nesting community, takes place mainly in the nest, while the animals are in close physical contact (SCHULTZE-WESTRUM 1965). A rest-time with a constantly low tendency to be active or even to leave the nest favours both behaviors.

Unfortunately nearly nothing is known about the behavior of *Db* in the field. ASLIN (1974) found *Db* in big burrow complexes. The activity recorded in the laboratory during the L-phase might occur in the natural habitat inside of the burrows. But if one takes into account that activity in *Db* was not masked by high L-intensities, the animals can be considered to be active and hunting outside of the burrows, possibly in the shelter of rocks and bushes, during daytime, too. In accordance to this, our *Db*-individuals always react directly to feeding during L-phase. They immediately kill their prey and start eating.

The daily pattern of activity and O<sub>2</sub>-consumption characterized by bouts – i.e. short-times of high alertness – during D- as well as during L-phase might be suitable for this most possibly opportunistic feeder, enabling it to hunt throughout the day and make use of various prey species with different activity patterns. So the essential temporal adaptation of a predator to the temporally varying abundance of its prey (DAAN 1981) in *Db* might be achieved by a pronounced short-term periodicity which is only slightly superimposed by the circadian rest-time and direct masking effects of illumination intensity.

#### Acknowledgements

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#### Zusammenfassung

*Tages- und Kurzzeitperiodik von Aktivität und Sauerstoffverbrauch bei drei dunkelaktiven Marsupialia-Arten: Petaurus breviceps, Phalangeridae; Dasyuroides byrnei, Dasyuridae; Monodelphis domestica, Didelphidae*

Zur Ermittlung artspezifischer Charakteristika der Tages- und Kurzzeitperiodik von Marsupialia-Arten mit unterschiedlicher Lebensweise wurden bei 4 *Petaurus breviceps* (*Pb*), 4 *Dasyuroides byrnei* (*Db*) und 2 *Monodelphis domestica* (*Md*) im Labor Simultanregistrierungen der Aktivität und des O<sub>2</sub>-verbrauchs durchgeführt. Bei *Pb*, bei dem außerdem noch die Körpertemperatur telemetrisch gemessen wurde, haben die drei Parameter im LD 12:12 (200:10<sup>-1</sup> lx) in den meisten Fällen einen bimodalen Verlauf, wobei ein steiler Anstieg bzw. Abfall jeweils unmittelbar nach Beginn und kurz vor Ende der D-phase erfolgt. Bei *Db* ist das eher unimodale Tagesmuster von Aktivität und O<sub>2</sub>-verbrauch durch einen allmählichen Anstieg und Abfall gekennzeichnet. *Md* hat bei beiden Parametern ein 3 bis 4 gipfliges durchschnittliches Tagesmuster. Während der D-phase zeigen Aktivität und O<sub>2</sub>-verbrauch bei allen Arten ausgeprägte kurzperiodische Variationen. In Gegensatz zu *Pb* können sich diese bei *Db* auch über die gesamte L-phase erstrecken. Die maskierende Wirkung hoher Lichtintensitäten ist bei *Db* gering. Dagegen führen 2stündige Störlichtpulse bei *Pb* und *Md* während der Aktivitätsphase zu einer deutlichen negativen Maskierung des Musters von Aktivität und O<sub>2</sub>-verbrauch. Die ermittelten zwischenartlichen Unterschiede in der circadianen und ultradianen Organisation der gemessenen Parameter könnten Anpassungen an unterschiedliche Lebensweisen darstellen.

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## *Lonchorhina aurita* Tomes, 1863 (Phyllostominae, Phyllostomidae, Chiroptera) im westlichen Ecuador

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### Abstract

*Lonchorhina aurita* Tomes, 1863 (Phyllostominae, Phyllostomidae, Chiroptera) in Western Ecuador

Morphological data are given from a series of thirteen specimens of *Lonchorhina aurita* from Western Ecuador. Measurements are compared with data from Mexico, Venezuela, East Ecuador and *L. a. occidentalis* from Western Ecuador. The taxonomical status of *L. a. occidentalis* is discussed, and it is concluded that *Lonchorhina aurita* is to be regarded as a monotypic species.

### Einleitung

Das Verbreitungsgebiet der seltenen neotropischen Fledermaus *Lonchorhina aurita aurita* Tomes, 1863 bezog lange Zeit neben Mittelamerika und weiten Teilen Südamerikas von Ecuador nur den östlich der Anden gelegenen Regenwald mit ein. Für das westliche Ecuador beschrieb ANTHONY im Jahre 1923 eine eigene Art der Gattung *Lonchorhina*, *L. occidentalis*, die später (SANBORN 1932) als Unterart von *L. aurita* eingestuft wurde und als solche trotz verschiedentlich geäußerter Bedenken (HERNANDEZ-CAMACHO und CADENA 1978; ALBUJA 1982) bis heute aufrechterhalten wird (TUTTLE 1970; GENOWAYS 1981).

In seiner 1982 erschienenen Monographie „Murciélagos del Ecuador“ erwähnt ALBUJA erstmals zwei westecuadorianische Fundorte für *Lonchorhina a. aurita* und gibt einige Körpermaße von sieben Exemplaren an.

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